

Office Memorandum

DATE : 2/05/2015

TO : Erik Smith

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SUBJECT : Dark River Class 1 Water Quality Standards

Background

The goal of this memo is to determine if projected surface water concentrations at the beginning of the 1B, 2A, 3B, 4A, 4B, 5,6 reach of the Dark River (AUID 0903005-525) are below or above water quality standards. A 1B, 2A, 3B waterbody is protected for drinking water use after disinfection; cold water aquatic communities and non-food industrial use with moderate treatment.

The Dark River begins near the Minntac tailing basin and flows westward. Flow in the initial reaches of the Dark River is dominated by the Minntac tailing basin drainage. The Dark River flows approximate 10 miles and through Dark Lake before it reaches the 1B, 2A, 3B, 4C, 5,6 designated reach. The Dark River and Dark Lake are designated as 2B, 3C, 4A, 4B, 5, 6 waterbodies until they reach the 1B, 2A, 3B reach.

The data set is based on two sampling events in May and June of 2014 at SD001. As such, there are a maximum of two data points for each analyte.

**All limits and conclusions found in the memo are intended to be preliminary.
This document is not a replacement of a waterbody assessment.**

Flow Calculations and Dilution Ratios

In order to adequately account for dilution, the 7Q₁₀ flow rate at the beginning of the 1B, 2A, 3B reach was calculated.

The 7Q₁₀ flow rate at discontinued USGS gauge #05131000 was calculated by the USGS as 2.975 cfs using the period of record of 1943 to 1979. The drainage area of #05131000 was calculated by the USGS as 58 square miles.

The drainage area at the beginning of the 1B, 2A, 3B was determined to be 38 square miles.

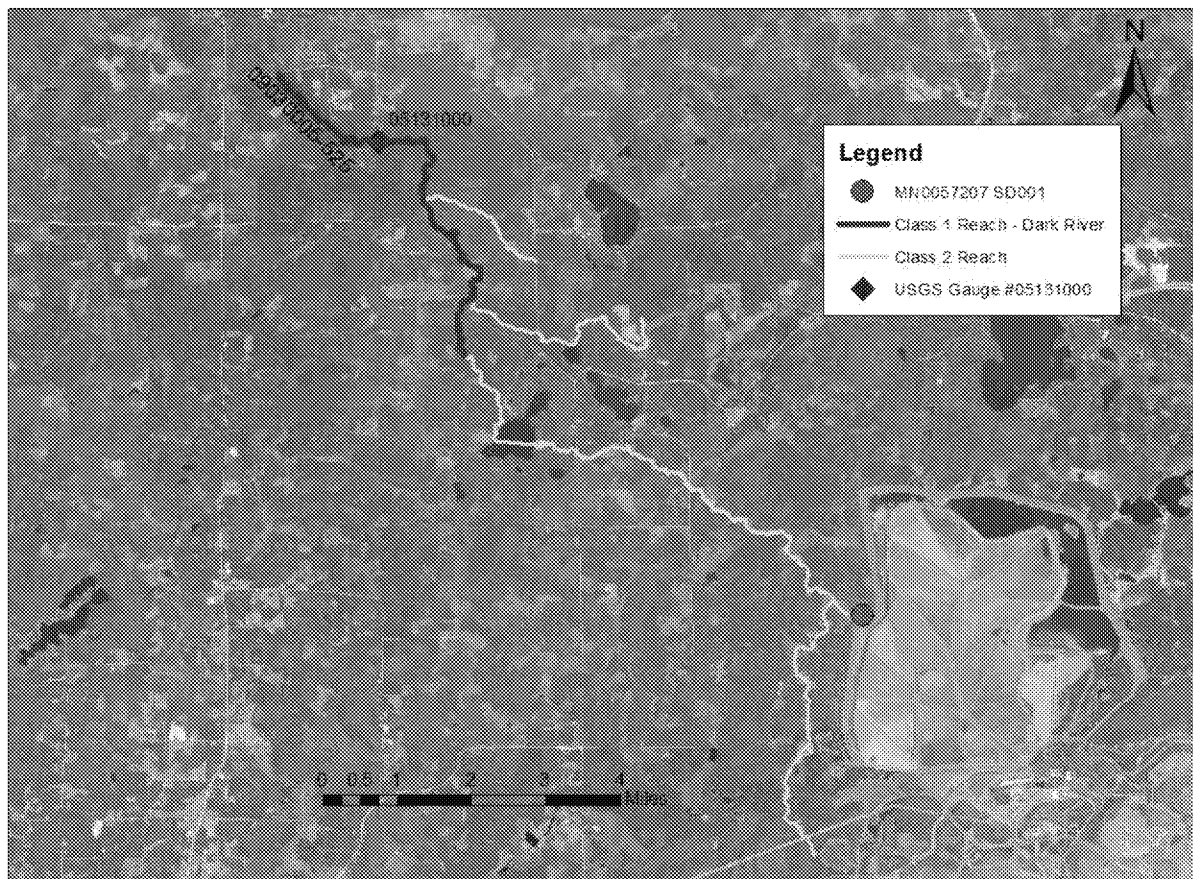
The 7Q₁₀ flow rate at the beginning of the 1B, 2A, 3B reach was calculated as 1.95 cfs. This was calculated by multiplying 2.975 cfs by the ratio the drainage area of #5131000 to the drainage area of the 1B, 2A, 3B reach.

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The flow rate exiting the Minntac tailings basin westward was assumed to be 1.7 mgd at 7Q10 conditions. The flow rate leaving SD001 was assumed to be 93 gpm at 7Q10 conditions.

The dilution ratio between the 7Q10 flow rate at the 1B, 2A, 3B reach and the flow exiting the Minntac tailing basin westward is 0.43. The dilution ratio between the 7Q10 flow rate at the 1B, 2A, 3B reach and SD001 is 0.043.

Figure 1. The class 1 reach of the Dark River is highlighted in red.



Concentration Analysis

A full reasonable potential analysis cannot be performed because a minimum of ten data points is required to perform a reasonable potential analysis.

Instead of a reasonable potential analysis, the available two data points for each parameter were averaged, adjusted for dilution and compared to applicable water quality standards. All of the parameters were assumed to be completely conservative with respect to their fate from SD001 to the beginning of the 1B, 2A, 3B reach. The stream dilution water was assumed to have a concentration of 0 mg/L for all parameters for the purpose of this analysis.

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The 2A limits for Cadmium, Chromium, Copper, Lead, Nickel and Zinc were calculated using the minimum hardness of 50 mg/L.

The dilution ratio of 0.043 was used for evaluating the Manganese concentration at the beginning of the 1B, 2A, 3B reach on the Dark River.

There were only possible exceedances of state standards for hardness, specific conductance and total dissolved solids at the beginning of the 1B, 2A, 3B reach when adjusted for dilution (See table below). Every other parameter did not have an exceedance of a state standard.

Sulfate was not evaluated against state standards because of the following reasons:

1. There are more than two collected data points for sulfate concentrations at SD001.
2. The MPCA is in the process of revising the Class 4A sulfate standard.
3. If a new sulfate standard was promulgated, the MPCA would need to develop a methodology to assess and implement that new standard.

Parameter	WQ Standards						SD001		SD001 Average	Likely Concentration at start of 1B reach	Above or Below Applicable Standards?
	1B	2A	3B	4A	4B	404	May-14	Jul-14			
Alkalinity (Bicarbonate as CaCO ₃) mg/L				250			503	420	461.50	196.44	Below
Bicarbonates (HCO ₃)				305			613.66	512.4	563.03	239.66	Below
Ammonia (unionized ug/L)		16					0.27	0	<0.27	<0.27	Below
Fluoride (mg/L)							1.4	1.4	1.40	0.60	Below
Hardness (Ca+Mg as CaCO ₃)			250				1690	1574	1632.21	694.78	Yes, 3C
pH		6.5-8.5	6-9	6-8.5	6-9		7.1	7.12	7.11	NA	NA
Nitrogen (mg/L)							<1.0	<1.0	<1.0	<1.0	Below
Nitrate - Nitrite (mg/L)							3.6	4.3	3.95	1.68	Below
Phosphorous (N lakes & Forest) ug/L		30					2	11	6.50	2.77	Below
Specific Conductance (uS/cm)				1000			2670	2689	2679.50	1140.57	Yes, 4A
Sulfate***											
TDS (mg/L)				700			2200	2230	2215.00	942.85	Yes, 4A
TSS (mg/L)		10				20-30	<1.0	3	≤3	≤3	No
Turbidity (NTU)		25						1.9	1.90	0.81	No
Aluminum Total (ug/L)		87					<5.6	<2.8	<5.6	<5.6	No
Antimony Total (ug/L)	6	5.5					<0.25	<0.5	<0.5	<0.5	No
Arsenic Total (ug/L)	10	2.0					0.81	1.2	1.01	0.43	No
Barium (ug/L)	2000						51.8	51.7	51.75	22.03	No
Beryllium (ug/L)	4						<0.018	0.054	≤0.054	≤0.054	No
Boron Total (ug/L)				500			270	217	243.50	103.65	No
Bromide (mg/L)							0.85	0.91	0.88	0.37	NA
Cadmium (ug/L)	5	0.66					<0.03	<0.059	<0.03	<0.03	No
Calcium (mg/L)								177	177.00	75.34	No
Chloride (mg/L)		230	100				131	139	135.00	57.46	No
Chromium (total) ug/L	100	117					<0.26	<0.62	<0.62	<0.62	No
Cobalt, Total (ug/L)		5					1.2	0.76	0.98	0.42	No
Copper (ug/L)	1300	6.4					3.2	<0.73	≤3.2	≤3.2	No
Iron Total (mg/L)	300					1-2	0.296	0.385	0.34	0.14	No
Lead (ug/L)	15	1.3					<0.028	<0.028	<0.028	<0.028	No

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Magnesium (mg/L)							275	275.00	117.06	No	
Manganese Total (ug/L)	50						1760	1730	1745.00	78.97	No
Mercury (ng/L)		6.9					0.81	0.355	0.58	0.25	No
Molybdenum (ug/L)							2.9	<2.3	≤2.9	≤2.9	No
Nickel (salts) ug/L		88					1.3	<1.1	≤1.3	≤1.3	No
Selenium (ug/L)	50	5					3.5	3.7	3.60	1.53	No
Silver (ug/L)	100	0.12					<0.1	<0.2	<0.2	<0.2	No
Thallium (ug/L)	2	0.28					0.1	<0.028	≤0.1	≤0.1	No
Tin (ug/L)							0.03	<0.053	≤0.03	≤0.03	No
Titanium (ug/L)							<10	<20	<20	<20	No
Zinc (ug/L)	5000	59					4	<0.54	≤4	≤4	No

***See explanation in text above.